

## AC Dependence of ED Dipole Transfer Ratio with and without Damping Resistor

the DC transfer ratio is known to be roughly 10 Gauss/amp for the ED Dipoles. For the case of ac currents however, eddy currents in the bore tube as well as the cryostat can shield the field region from the effects of these currents, thus decreasing the effective transfer ratio. In addition, when a damping resistor is used to damp oscillations in the ED magnet string, it will shunt ripple currents away from the coil entirely.

A 53 turn coil, roughly 2" x 40" (Total area  $2.57 \text{ m}^2$ ) was inserted into a warm ED dipole which was excited with a sine wave generator. The magnitude of the excitation current as well as its phase was monitored across a series  $10\text{ }\Omega$  resistor. typical excitation currents were  $\sim 300 \text{ mA}$ . A  $20\text{ }\Omega$  damping resistor was placed directly across the coil bus. This is equivalent to placing a  $80\text{ }\Omega$  resistor across the quench protection leads for every half-cell.

The results are shown in Figs 1 and 2. In the case of the measurements with the damping resistor, a small correction (24% at  $10 \text{ Hz}$ , 8% at  $100 \text{ Hz}$ ) in the amplitude measurement was made to compensate for the finite coil resistance ( $4.8\text{ }\Omega$ ) at room temperature. A similar correction in the phase angle was made also. Eddy current measurements of warm and superconducting magnets are not significantly different, as they depend on the resistivity of stainless steel ( $\rho = 75 \mu\text{ohm}\cdot\text{cm}$  @  $20^\circ\text{C}$ ;  $53 \mu\text{ohm}\cdot\text{cm}$  @  $4^\circ\text{K}$ ). This was shown to be the case in UPC #31 - Eddy Current Measurements. So we

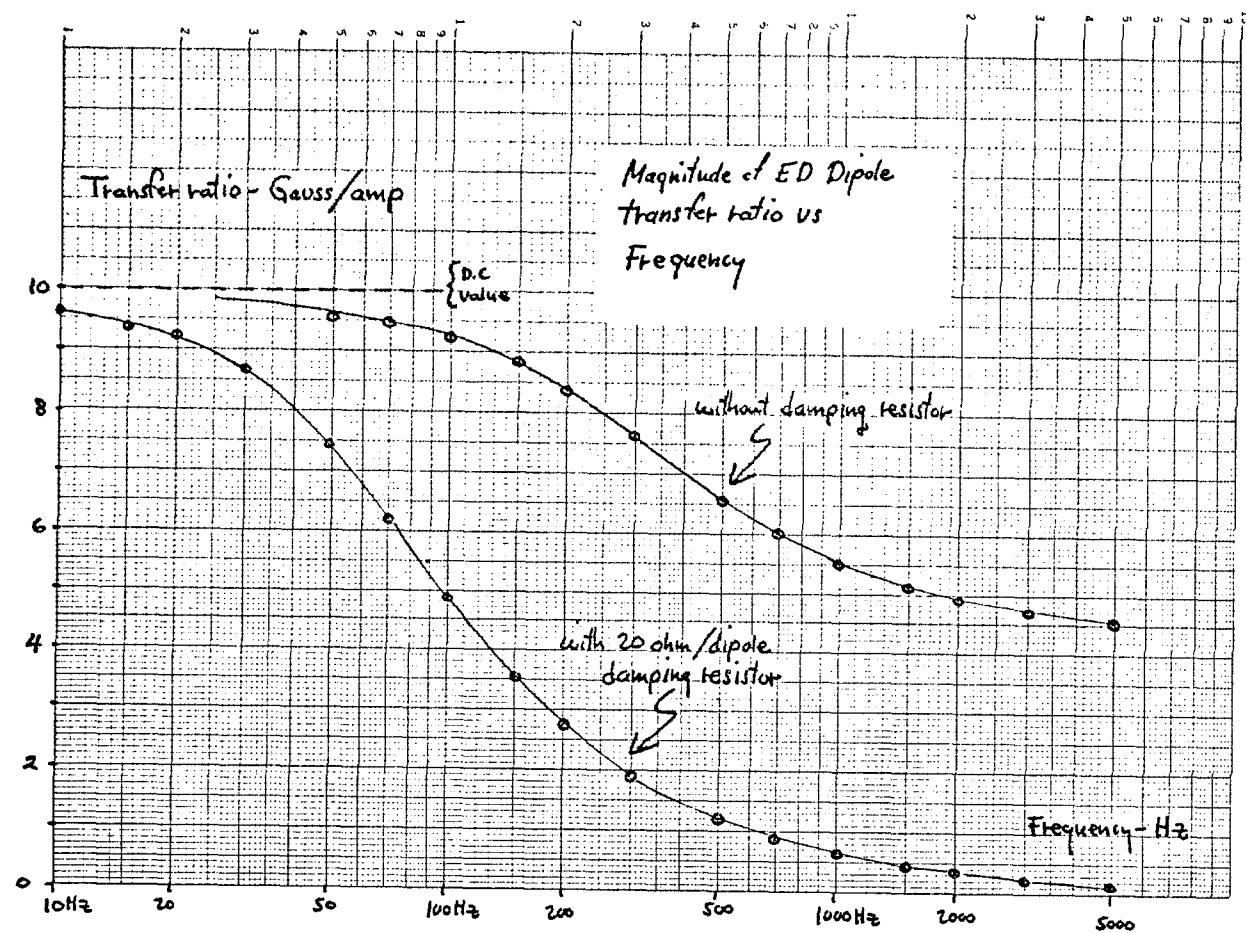
can assume that these results reasonably approximate the case when the dipoles are superconducting.

The most important ripple currents are expected to be at 120 Hz and 720 Hz. Measurements show that a damping resistor of 20 ohms/dipole reduces the ripple field by factors of 2 and 7 respectively at these frequencies. In addition, the power loss associated with these ripple currents is now dissipated externally to the cryostat and will not appear as a heat load on the He system.

It should be noted however, that as the power supply ripple is a voltage source, that adding a 20Ω damping resistor increases the ripple currents by about 40% and 150% respectively at 120 Hz and 720 Hz respectively, based on transmission line theory calculations.

These measurements will be continued at B12 where we can look at the ripple fields in a string of superconducting magnets. Some measurements have been made at the Magnet Test Facility; however, as their equipment has limited frequency range and the magnets out of necessity have a warm-bore assembly (which attenuates ac fields), these measurements should be done at B12.

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